Chapter 7
Sensitive Species

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7.0 SENSITIVE SPECIES

The restoration design of Batiquitos Lagoon included elements to promote the nesting of several sensitive avian species, including California least tern (*Sternula antillarum browni*), western snowy plover (*Charadrius alexandrinus nivosus*), and Belding's Savannah sparrow (*Passerculus sandwichensis beldingi*). These elements included the creation of five nesting sites for least terns and snowy plovers and increasing areas of pickleweed (*Sarcocornia pacifica*) dominated salt marsh habitat for Belding's Savannah sparrows. The five nesting sites were created through placement of sand dredged during the restoration process and were designated as W-1 and W-2 in the west basin and E-1, E-2, and E-3 in the east basin (Figure 6-1). Site W-1 was completed in time for the 1994 nesting season, with sites W-2 and E-1 ready for the 1995 season, and sites E-2 and E-3 completed before the 1996 nesting season. Additional salt marsh habitat was created through excavation of the lagoon basins to appropriate tidal elevations, limited transplants, and natural recruitment of pickleweed. To encourage occupation by light-footed clapper rails (*Rallus longirostris levipes*), cordgrass (*Spartina foliosa*) was transplanted onto the mudflats of the lagoon shortly after the restoration (See Chapter 4).

To document the result of these efforts, breeding surveys were conducted following the restoration. Surveys of Belding's Savannah sparrow territories post-restoration were conducted in 1997, 1998, 1999, 2001, and 2006 by Merkel & Associates (M&A) biologists, K. Keane of Keane Biological Consulting, and A. Whelchel of Wetlands Research Associates (WRA). California least tern and western snowy plover nesting was monitored annually by California Department of Fish and Game (CDFG). Light-footed clapper rails were surveyed annually by CDFG.

7.1 METHODS

7.1.1 Belding's Savannah Sparrow

Surveys for the state endangered Belding's Savannah sparrow were performed in April and June, the beginning and middle/end of the breeding season, in monitoring years 1, 2, 3, 5, and 10 (1997, 1998, 1999, 2001, and 2006). All areas with potentially suitable breeding habitat for the Belding's Savannah sparrow (pickleweed dominated salt marsh) were surveyed (Figure 7-1). The expansion of pickleweed habitat within the lagoon resulted in the addition of survey areas and survey duration over the length of the program. Eight use areas were identified as supporting Belding's Savannah sparrows. Area 1 (A-1) was located along the eastern portion of the east basin and was bordered to the east by El Camino Real, to the west by the eastern edge of the E-2 nesting site, and to the south by Encinitas Creek. Area 2 (A-2) was on the north shore of the east basin along the northern edge of the E-2 nesting site, on all margins of E-2, and extending west to the golf clubhouse at Aviara. Area 3 (A-3) was also located along the north shore of the east basin, to the west of Area 2. A-3 was bordered to the east by the golf clubhouse and to the west by the parking lot and trail entrance off Batiquitos Drive. Area 4 (A-4) was in the southwest portion of the east basin and included marsh adjacent to La Costa Avenue and Interstate 5 (I-5) and the outer edge of the E-1 nesting site to the north. Area 5 (A-5) was located in the central basin, with occupied territory only on the western shores and bordered to the west by the train tracks. Area 6 (A-6) was located along the southern edge of the west basin and

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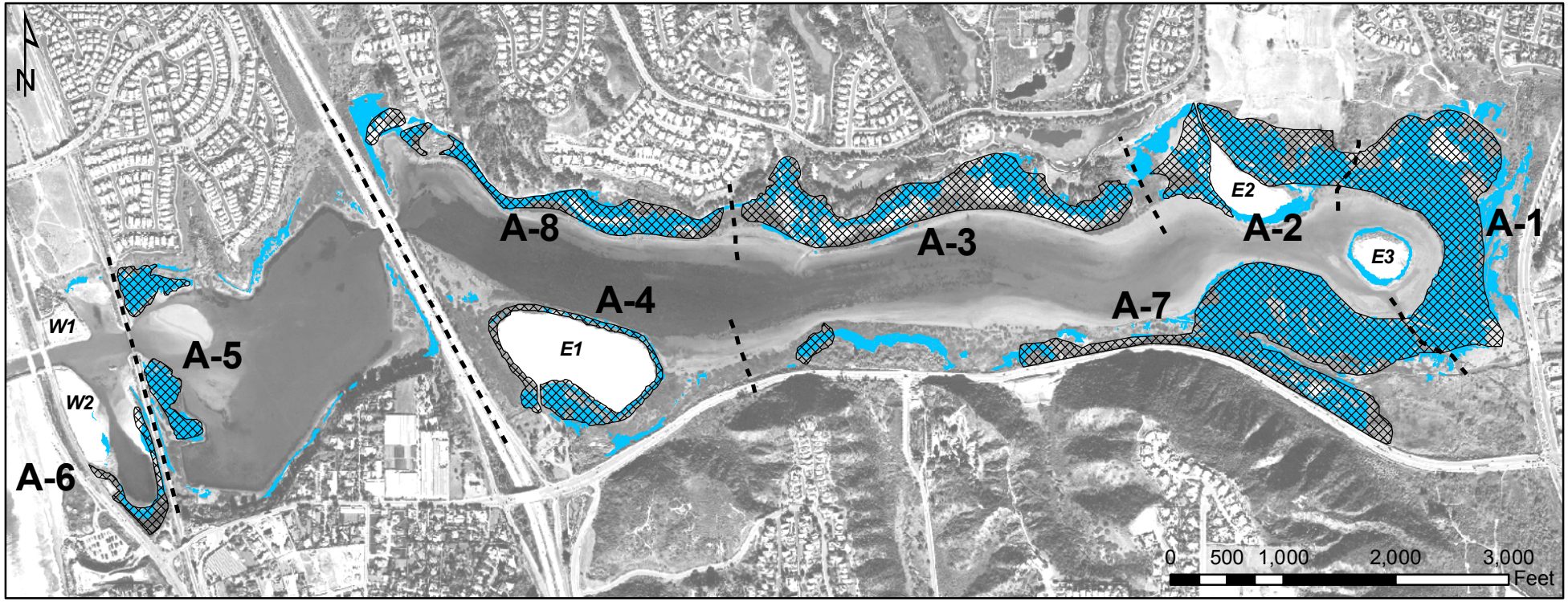

Occupied use areas (2006) Potential habitat surveyed (2006)

Belding's Savannah sparrow habitat surveyed and occupied use areas (2006)

Figure 7-1

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included small strips of salt marsh near the sewer pump station and in the median dividing west and east Carlsbad Boulevard. Area 7 (A-7) was a survey area occupied later in the survey years, located along the southern shoreline of the east basin, bordered to the south by La Costa Avenue and to the east by Encinitas Creek. Area 8 (A-8) was also an additional zone established on the northwestern shoreline of the east basin, bordered by I-5 to the west and the parking lot and trail entrance off Batiquitos Drive to the east.

Suitable habitat along the lagoon was surveyed on foot by multiple teams of two biologists each using binoculars and spotting scopes. Surveys occurred at the beginning and end of the breeding season. These surveys were typically completed within one day and were performed between 0530 hours and 1100 hours on each of the survey dates. In 2006, multiple survey dates were needed to complete the surveys due to the large amount of suitable habitat available at the lagoon. Weather conditions, including air temperature, cloud cover, precipitation, and approximate wind speed, were recorded at the beginning and end of each survey. The two surveyors assessed all suitable habitat, moving at a steady pace and taking care to avoid the double-counting of individuals. Data recorded on site maps included location, number of birds observed, and behaviors such as vocalizations (call notes and songs), nesting activities, perching, chasing, and fleeing. The presence of potential predators was also noted.

From the field data collected, the number and approximate locations of individuals, paired birds, and territories were estimated per methods used during statewide censuses for this species, as summarized in Zembal et al. (1988). Each observation of a singing male, a female and male perching together for an extended time period (assumed to be a pair), nest building, feeding young, aerial chases, the presence of a family group, and prolonged perching by the male was used as an indication of a territory. A precise determination of territories cannot be derived by only two 1-day surveys. Thus, the calculated numbers of territories in this study are broad estimates only; but since the same methods have been used at Batiquitos Lagoon in each monitoring year, it is possible to compare results over time. The U.S. Fish and Wildlife Service (USFWS) and CDFG have used this method consistently when the scope of the surveys does not include precise determination of the locations and/or number of territories present.

7.1.2 California Least Tern and Western Snowy Plover

Breeding surveys and nest monitoring for the California least tern and western snowy plover sites within Batiquitos Lagoon were performed annually by CDFG. The methodology utilized for these surveys is provided in the most recent monitoring report available from CDFG, the 2001 annual monitoring report (Bache and Wolf 2001). All data were provided by CDFG and are summarized within this final report to provide continuity and completeness in the lagoon reporting program. Data on the nesting of black skimmers (*Rynchops niger*) was opportunistically collected by the tern and plover monitoring teams and provided through personal communication.

7.1.3 Light-footed Clapper Rail

Population assessments for the light-footed clapper rail were conducted at Batiquitos Lagoon as part of statewide annual census efforts led by Dick Zembal for CDFG. The methodology for these surveys is described in the 2006 annual monitoring report (Zembal et al. 2007). All population data reported here are from this report.

7.2 RESULTS

7.2.1 Belding's Savannah Sparrow

Belding's Savannah sparrows historically nested at Batiquitos Lagoon prior to the restoration effort. Approximately 20, 47, and 28 breeding territories were observed in 1977, 1987, and 1988, respectively, located primarily along the northern shoreline of the east basin (CH2M Hill 1989). In 1991, prior to the restoration effort, 50 territories were located within the lagoon (Zembal et al. 2006). In 1996, after the completion of the restoration effort but prior to the opening of the mouth of the lagoon, 36 territories were observed (Zembal et al. 2006).

As the pickleweed dominated salt marsh habitat recovered from construction activities and began to expand post-restoration, usage by Belding's Savannah sparrows increased as well (Figure 7-2). More importantly, the population trends became more stable and less susceptible to climatic variability and closed lagoon ponding. With the increase in available nesting habitat, the transition of brackish marsh habitat to pickleweed dominated coastal salt marsh, and the likely dispersal of young birds into the expanding habitats, the number of territories increased steadily. Figure 7-2 shows the increase in Belding's Savannah sparrow breeding territories plotted with the increase in pickleweed nesting habitat.

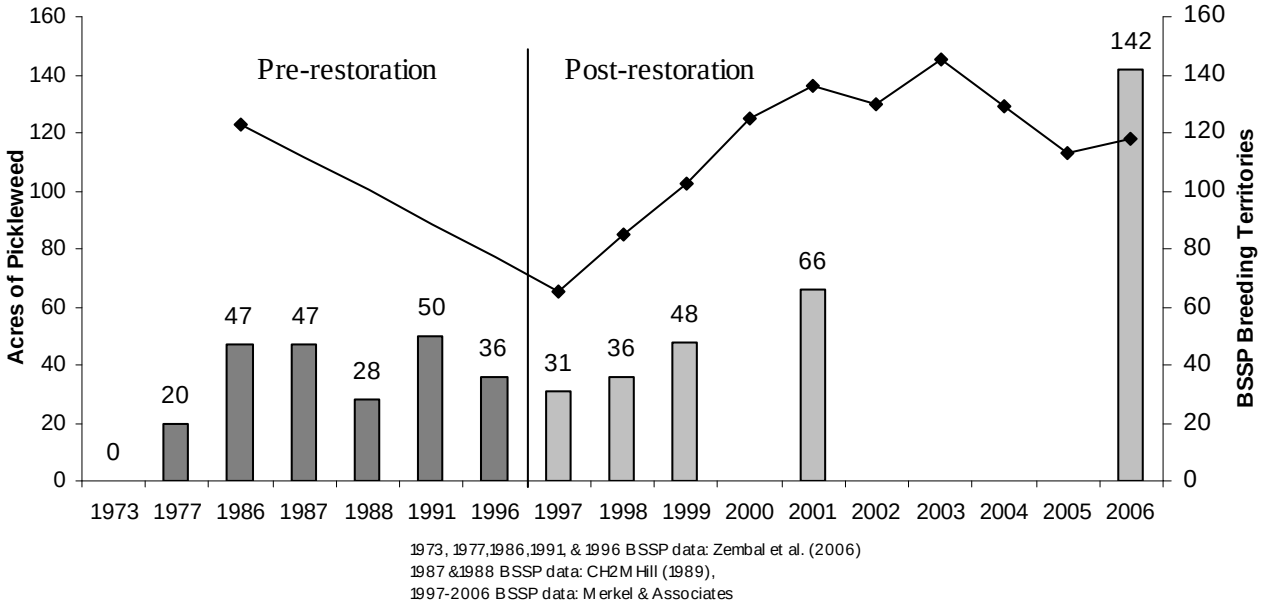

Figure 7-2. Belding's Savannah sparrow breeding territories (bars) and pickleweed coverage (line) pre- and post-restoration.

A summary of the number of individuals, pairs, and territories detected during the 1997, 1998, 1999, 2001, and 2006 surveys is presented in Table 7-1. The number of individuals listed in the table represents the total number of Belding's Savannah sparrow observations, including pairs listed in the next row. The number of pairs listed represents observations of two individuals observed in close proximity or otherwise interacting as a pair and not demonstrating territorial defensive behavior to one another. The number of territories includes observed pairs plus birds engaged in the territorial behaviors described above.

Table 7-1. Summary of Belding's Savannah sparrow breeding territories 1997-2006.

		Area	1	2	3	4	5	6	7	8	Totals
1997	April 5, 97	Individuals	31	16	3	9	4	5	0	0	68
		Territories	12	8	1	5	3	2	0	0	31
	June 4, 97	Individuals	36	7	0	8	2	5	0	0	58
		Territories	20	5	0	3	1	1	0	0	30
1998	April 25, 98	Individuals	26	35	2	7	5	6	0	0	81
		Pairs	3	10	1	1	2	1	0	0	18
		Territories	5-10	11-14	1	3	2	3	0	0	25-33
	June 4, 98	Individuals	40	35	2	4	9	1	0	0	91
		Pairs	11	6	0	1	3	0	0	0	21
		Territories	12-15	9-13	1	2	4	1	0	0	29-36
1999	April 21, 99	Individuals	66	12	9	5	7	3	0	0	102
		Pairs	21	4	3	2	3	1	0	0	34
		Territories	28	5	6	3	4	2	0	0	48
	June 8, 99	Individuals	53	11	15	6	7	3	4	0	99
		Pairs	9	1	4	3	2	1	0	0	20
		Territories	17	3	4	3	4	2	0	0	33
2001	April 23, 01	Individuals	65	27	7	34	2	0	12	3	150
		Pairs	15	7	1	9	1	0	2	1	36
		Territories	27	14	3	12	1	0	7	2	66
	June 22, 01	Individuals	64	38	11	44	4	0	1	2	164
		Pairs	9	9	3	12	2	0	0	1	36
		Territories	31	12	3	12	2	0	1	1	62
2006	April 13, 06	Individuals	74	48	9	38	4	1	62	11	247
		Pairs	5	15	3	13	0	0	12	4	52
		Territories	55	29	6	17	4	1	23	7	142
	June 20, 06	Individuals	50	28	10	37	11	1	76	7	220
		Pairs	0	0	0	0	1	0	5	0	6
		Territories	36	19	8	20	7	1	47	4	142

Immediately following restoration, the pickleweed habitat used by Belding's Savannah sparrows for nesting was extensive at the far eastern end of the east basin, but patchy, disturbed, or occurring in narrow bands throughout much of the rest of the lagoon. At the time of the first and second surveys, only six areas were identified as being occupied by territories (Areas 1-6, Figure 7-1). By 1999, an additional area (Area 7) along the southern edge of the east basin was used. By 2001, an eighth area (Area 8) along the northwestern shore of the east basin was used as well. By 2006, Batiquitos Lagoon supported the largest amount of suitable habitat occupied by territorial Belding's Savannah sparrows (Figure 7-1).

Belding's Savannah sparrow activity in each of these eight areas is described below. It may be useful to refer to the habitat maps in Chapter 3 to track the changes in availability of pickleweed habitat in each area over time.

Area 1 (the far eastern end of the east basin) consistently supported the highest concentration of Belding's Savannah sparrows due to the large expanses of pickleweed dominated salt marsh. Immediately after the restoration effort, the area consisted of a mix of salt marsh, brackish marsh, and freshwater marsh with approximately 20 territories. Over time, the restored tidal influence transitioned much of the freshwater and brackish marsh communities to salt marsh, with the number of territories increasing each year, with as many as 55 territories in this area by 2006.

Area 2 (the north shore of the east basin in the vicinity of the E-2 nesting site) supported the second highest concentration of Belding's Savannah sparrows over the study period. Expansion of the salt marsh was also seen in this area, increasing the available habitat over time, particularly at the east and west ends of E-2. The majority of the individuals were located in the linear stretch of salt marsh located north of E-2 and in later years in the ring of salt marsh that expanded to encircle E-2. The number of territories in Area 2 increased from approximately 8 to 29 between 1997 and 2006.

Area 3 (along the central north shore of the east basin) was used in relatively low numbers, increasing from one to six territories in the first three years (1997, 1998, 1999), decreasing to three in 2001, and increasing to eight in 2006. Birds in this area and Area 8 were frequently observed moving back and forth to sing and forage between the more dense and wide salt marsh at upper elevations and the more sparse marsh and mudflat at lower elevations. In 1998, a nest was inadvertently discovered during the survey. It was 10 cm high and 8 cm wide at its top and was constructed at ground level within salt marsh dominated by pickleweed and alkali heath (*Frankenia salina*).

Area 4 (in the southwest portion of the east basin near the E-1 nesting site) initially only supported salt marsh immediately south of E-1, though five territories were documented there in 1997. Salt marsh quickly expanded to form a continual fringe around E-1 that was regularly used by Belding's Savannah sparrows beginning in 2001, including individuals displaying territorial behavior in extensive areas of salt grass (*Distichlis spicata*) rather than pickleweed. A total of 12 territories were mapped in Area 4 in 2001. By 2003, (not a Belding's Savannah sparrow survey year) the salt marsh had expanded out onto the

previously unvegetated mudflat to the west of E-1 and was likely also used by Belding's Savannah sparrows at that time. By 2005 and 2006, however, this pickleweed dominated salt marsh had transitioned to a cordgrass dominated salt marsh. With the dominance by cordgrass, the sparrows may have retreated to the remaining areas of pickleweed by 2006; however, there were still up to 20 territories documented in 2006.

Area 5 (western shoreline of the central basin) only had two to four territories from 1997 to 2001, all located on the large expanse of pickleweed dominated salt marsh located adjacent to the railroad corridor to the north and south of the railroad bridge. In 2006, approximately seven territories were observed in these two areas of dense salt marsh. Despite the expansion of pickleweed on the shoreline of the south, east, and north shores of the basin, Belding's Savannah sparrows were never observed on territories in these areas, possibly due to the narrow shoreline band within which the marsh was restricted.

Area 6 (west basin and the median between east and west Carlsbad Boulevard, just west of the west basin) supported territories only in the median following the restoration, with no Belding's Savannah sparrow holding territories in the west basin itself. The median had two to three territories from 1997 to 1999, with none detected in surveys in 2001 or 2006. The first observation of territorial Belding's Savannah sparrows in the west basin since completion of the restoration was made in 2006. One singing male was observed flying between patches of pickleweed south of the W-2 nesting site to narrow strips of pickleweed below the railroad tracks and at the southern end of the west basin.

Area 7 (along the south shore of the east basin) was added in 1999 when Belding's Savannah sparrows began to use the slightly expanding marsh there. Four individuals were observed foraging, but no breeding territories were identified within this area. In 2001, the salt marsh at the east end of Area 7 (the large knob of marsh extending east toward Encinitas Creek) had lost much of its freshwater and brackish marsh components and formed dense expanses of monotypic pickleweed. Between one and seven territories were identified in this area. By 2006, the large area of salt marsh in Area 7 experienced the largest increase in territories, with between 23 and 47 territories being identified. A substantial amount of activity by a mix of Belding's Savannah sparrows and song sparrows (*Melospiza melodia*) was identified in this area during the 2006 surveys. Surveyors spent additional time in this area to confirm territorial behavior and species identification and to avoid double-counting individuals and/or territories.

Area 8 (along the northwest shore of the east basin) was added in 2001 when Belding's Savannah sparrows were first observed to use the salt marsh in the northwestern shoreline of the east basin as the pickleweed fringe expanded. In 2001, there were two territories identified, and in 2006 there were seven territories within this area.

7.2.2 Western Snowy Plover

A compilation of western snowy plover breeding activity data synthesized from data compiled by Keane Biological Consulting, WRA, and CDFG from 1995 to 2006 is presented in Figure 7-3. CDFG breeding season reports have not yet been prepared for 2001 through 2006; however, the CDFG snowy plover monitor for most of those years provided a copy of draft results for

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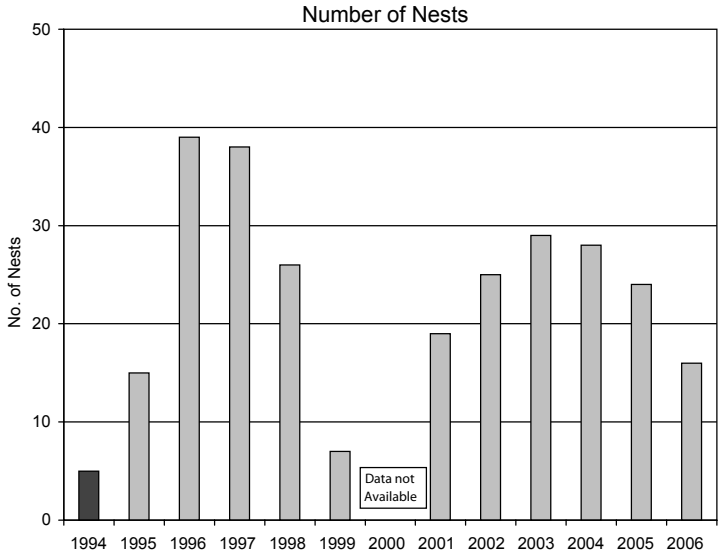

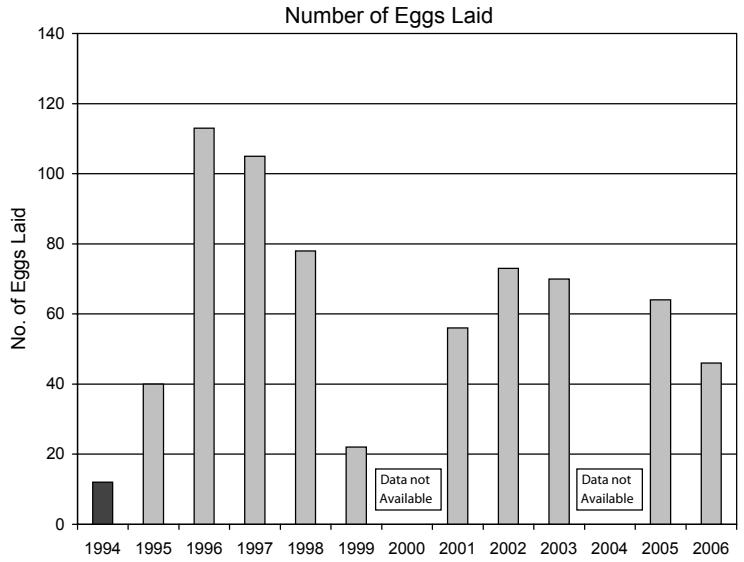

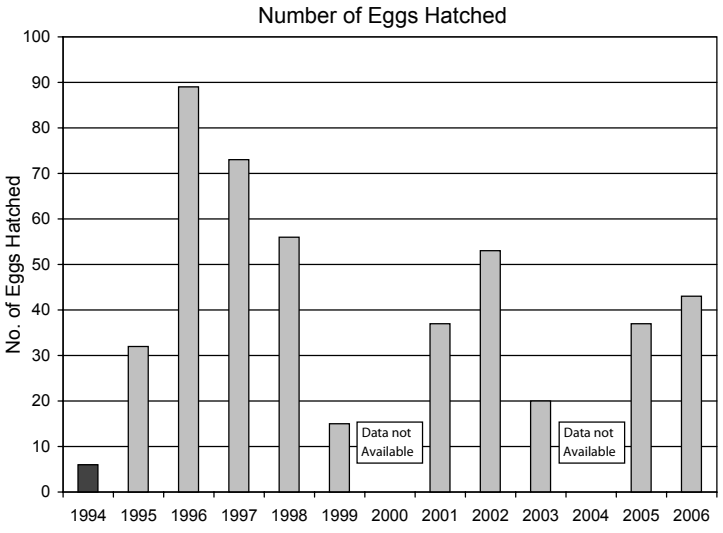

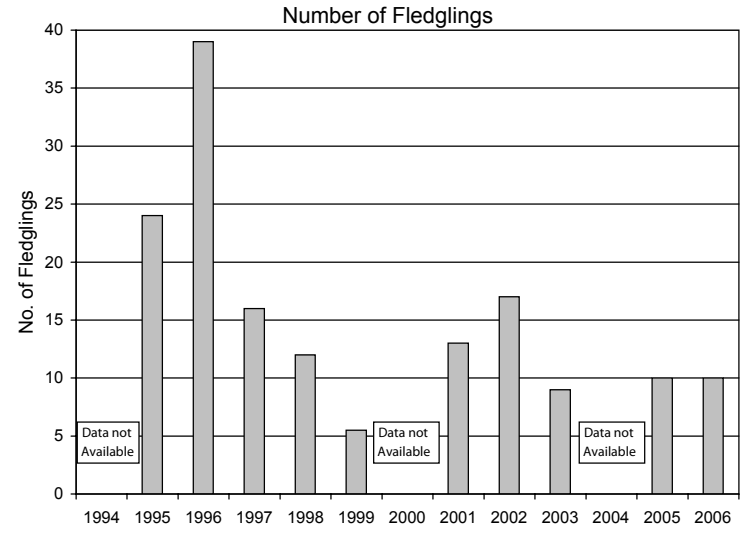

Summary of western snowy plover nesting history within Batiquitos Lagoon before nesting sites (1994-only W1 constructed) and after nesting sites (1995-2006)
data source: California Department of Fish and Game

Figure 7-3

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inclusion in this report (Wolf 2008a, b, c, d). Data from 2004 are not available. All other data, including historical data, are otherwise referenced throughout this section.

Prior to the creation of the nesting sites within the lagoon, western snowy plover nesting activity was limited. In 1978, no juveniles or nests were located at Batiquitos Lagoon. In 1983, two juveniles and one nest were located, and in 1988, no nests were located, but the presence of five juveniles indicated some nesting activity had occurred (CH2M Hill 1989, City of Carlsbad and U.S. Army Corps of Engineers 1990). In 1994, during the restoration, five nests were established on the north shore of the east basin. Following the creation of the sites in 1995 and 1996, snowy plover nesting was observed at the three nesting sites located in the east basin (E-1, E-2, and E-3) and in low numbers at one of the two sites in the west basin (W-2). Site W-1 has never been used by snowy plovers. The nesting data collected at each of the sites was supplied by Keane Biological Consulting, WRA, and CDFG and is presented in Table 7-2. Grayed-out boxes indicate time periods prior to the creation of the nesting site.

The population of nesting snowy plovers at Batiquitos Lagoon fluctuated over the period of this study. The numbers were very low in 1994, prior to the creation of the nesting sites, with only five nests located. Snowy plover nesting increased following the creation of the lagoon nesting sites, with the highest numbers of nests (39), eggs (113), eggs hatched (89), and fledglings (39) occurring in 1996, the first year the site was available. Nesting activity declined after the completion of construction, dropping to seven nests in 1999. No data are available for 2000. In 2001, plover nesting reversed the downward trend and rose through 2003 and then declined to 16 nests in 2006.

The hatch rate (percent of total eggs laid that survived to hatch) for the western snowy plover fluctuated over the years, ranging from between 29% in 2003 to 93% in 2006 (Table 7-2). Generally, egg loss in snowy plovers is due to non-viable eggs, abandonment, or nest predation. The principal source of egg loss at Batiquitos Lagoon was probably due to nest predation though data to document this are not available. The fledge rate (percent of total hatched chicks that survived to fledge) was fairly high in 1995 (75%) but fluctuated between 21% and 45% in subsequent years (Table 7-2). These fluctuations in fledge rate are difficult to explain without data from the CDFG monitoring program, but they may be related to predation or isolation from foraging areas due to overgrowth of vegetation at the base of the nesting sites. The overall nest success (fledglings per nest) fluctuated from year to year, with the average being estimated at 0.69 fledglings per nest.

Table 7-2. Western snowy plover nesting data from 1994-2006 (nesting sites partly completed in 1994/1995 and fully completed by 1996).

Number of Nests													
Colony	**1994***	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
E-3			12	16	16	5	no data	5	1	7	6	8	5
E-2			3	4	4	0	no data	0	0	2	2	4	0
E-1		15	24	18	4	1	no data	13	23	18	17	8	10
W-2		0	0	0	2	1	no data	1	1	2	3	4	1
W-1		0	0	0	0	0	no data	0	0	0	0	0	0
all sites	**5***	**15**	**39**	**38**	**26**	**7**	**no data**	**19**	**25**	**29**	**28**	**24**	**16**
Number of Eggs Laid													
Colony	**1994***	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
E-3			36	46	48	16	no data	14	1	20	no data	25	15
E-2			8	9	12	0	no data	0	0	5	no data	7	0
E-1		40	69	50	12	3	no data	39	69	39	no data	26	28
W-2		0	0	0	6	3	no data	3	3	6	no data	6	3
W-1		0	0	0	0	0	no data	0	0	0	no data	0	0
all sites	**12***	**40**	**113**	**105**	**78**	**22**	**no data**	**56**	**73**	**70**	**no data**	**64**	**46**
Number of Eggs Hatched													
Colony	**1994***	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
E-3			36	32	44	9	no data	9	0	7	no data	12	14
E-2			4	8	3	0	no data	0	0	2	no data	5	0
E-1		32	49	33	3	3	no data	25	50	10	no data	17	26
W-2		0	0	0	6	3	no data	3	3	1	no data	3	3
W-1		0	0	0	0	0	no data	0	0	0	no data	0	0
all sites	**6***	**32**	**89**	**73**	**56**	**15**	**no data**	**37**	**53**	**20**	**no data**	**37**	**43**
hatch rate**		**80%**	**79%**	**70%**	**72%**	**68%**	--	**66%**	**73%**	**29%**	--	**58%**	**93%**
Number of Fledglings													
Colony	**1994***	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
E-3			12	7	no data	4	no data	4.5	0	2	no data	4	1
E-2			3	1	no data	0	no data		0	1	no data	1	0
E-1		24	24	8	no data	1.5	no data	7.5	17	5	no data	2	7
W-2		0	0	0	no data	0	no data	1	0	1	no data	3	2
W-1		0	0	0	no data	0	no data		0	0	no data	0	0
all sites	**no data**	**24**	**39**	**16**	**12**	**5.5**	**no data**	**13**	**17**	**9**	**no data**	**10**	**10**
fledge rate***		**75%**	**44%**	**22%**	**21%**	**37%**	--	**35%**	**32%**	**45%**	--	**27%**	**23%**
nest success****		**1.6**	**1.00**	**0.42**	**0.46**	**0.7**	--	**0.68**	**0.68**	**0.31**	--	**0.41**	**0.62**

* Nesting in 1994 occurred on the north shore of the east basin, not at a nesting site.

** Hatch rate: (percent of total eggs laid that survived to hatch)

*** Fledge rate: (percent of total hatched chicks that survived to fledge)

**** Nest success: (fledgling per nest)

Data Sources: Wetlands Research Associates & Keane Biological Consulting annual monitoring reports
California Department of Fish and Game data and unpublished notes (S. Wolf)

7.2.3 California Least Tern

A summary of California least tern nesting productivity at Batiquitos Lagoon is presented in Figure 7-4, compiling data from CDFG statewide Least Tern Breeding Survey Annual Reports (Caffrey 1995, 1998; Keane 1998a, 1999, 2001, Patton unpub. drafts, Patton 2002b, Marschalek 2005, 2006, 2007). Table 7-3 presents the usage of each of the nesting sites following their construction using the above sources as well as unpublished draft field data provided by CDFG nesting site monitor Shauna Wolf. Prior to the initiation of statewide monitoring, data on least tern nesting at Batiquitos Lagoon dated back to 1969 (California Coastal Conservancy 1987). Because these records are not as complete with respect to fledging success, they have not been plotted graphically. Records for tern nesting collected prior to the commencement of CDFG surveys in 1978, however, include: 1969 (3+ pairs), 1973 (32+ pairs), 1974 (56-70 pairs), 1975 (9 pairs with two young fledged), 1976 (9 pairs), and 1977 (11 pairs).

Following the construction of the five nesting sites (W-1 in 1994, W-2 and E-1 in 1995, and E-2 and E-3 in 1996), the total number of least tern nests rose and leveled off at around 200 (range 172-298) each year, then increased dramatically again in 2003, remaining steady at around 600 (range 592-627) nests. The increased nests led to increased eggs laid and chicks (eggs hatched) and a modest increase in the number of fledglings (Figure 7-4).

The hatch rate (percent of total eggs laid that survived to hatch) for the least tern remained relatively high from 1994 through 2003, at between 82% and 97%, with the exception of two years: 1998 at 68% and 1999 dropping to 35% (Table 7-3). In 2005 and 2006, the hatch rate declined to a rate of 78% and 73%, respectively. In contrast, the number of chicks that survived to fledge was averaged at 54% from 1994 until 1997 and then dropped to an average of 20% from 1998 until 2006. The lowest fledgling production was observed in 1999, when the hatch rate dropped to 35% and the fledge rate (percent of total hatched chicks that survived to fledge) was only 9%. The low hatch rate was attributed to nest abandonment at W-2 and the loss of all nests at E-2 to nest predation (Keane 2001). There were no indications in the annual report as to causative agents for the high loss of chicks. The overall nest success (fledglings per nest) averaged 0.96 from 1994 to 1997 then dropped to an average of 0.25 fledglings per nest from 1998 to 2006 (Table 7-3).

Figure 7-5 presents historic and post-restoration data on the number of breeding pairs (generally lower than the number of nests due to repeat nesting by some pairs), the number of fledglings, and the resulting production rate (fledglings produced divided by number of breeding pairs each season). There has been a more than ten-fold increase in the number of breeding pairs since the creation of the nesting sites in 1994; however, the fledgling production has not followed the same trend, with the production rate at an average of 0.87 fledglings/pair prior to the restoration (1978 to 1993), rising to an average of 0.97 fledglings/pair during construction (1994-1996), and falling to an average of 0.35 after the restoration (1997-2006) (Figure 7-5). Note that this rate is based on the number of breeding pairs, whereas the values presented above in Table 7-3 are based on the number of nests.

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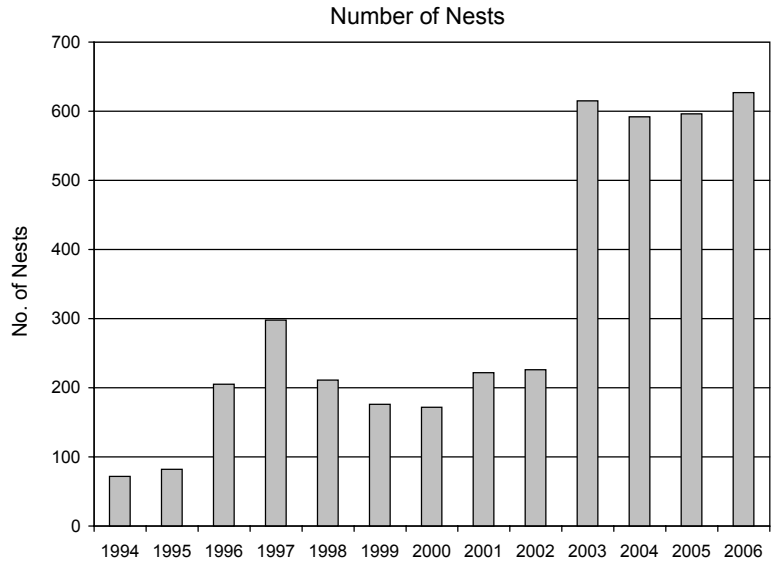

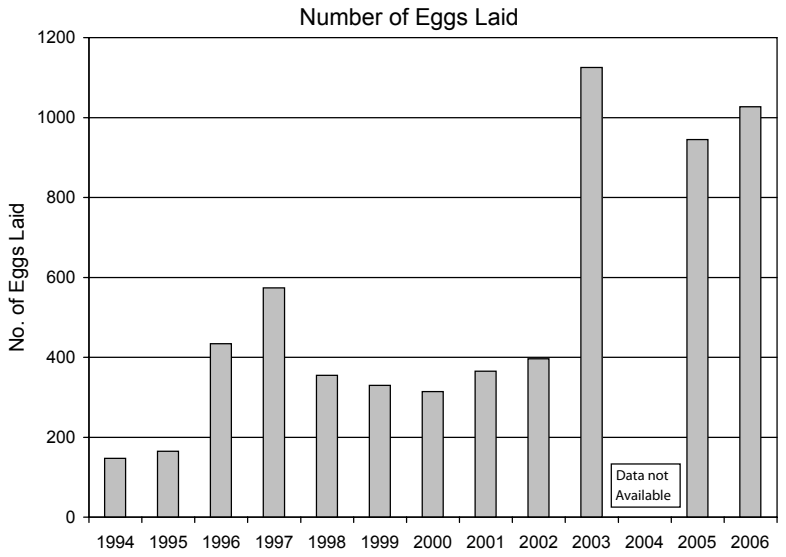

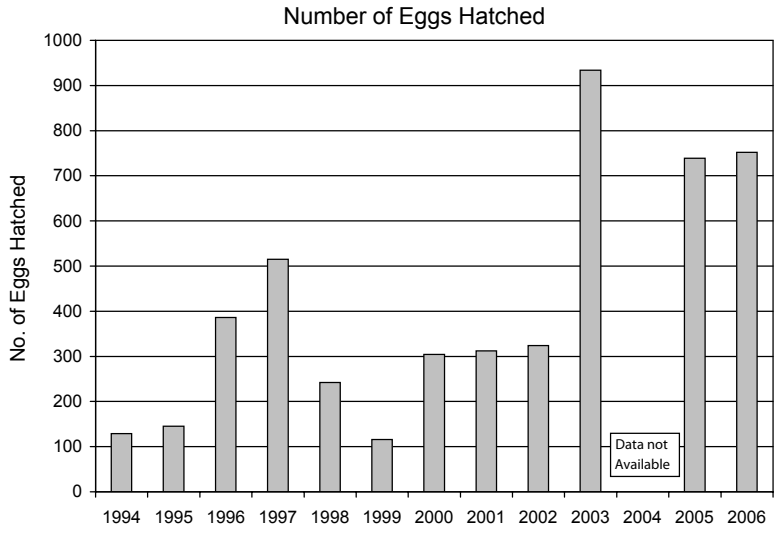

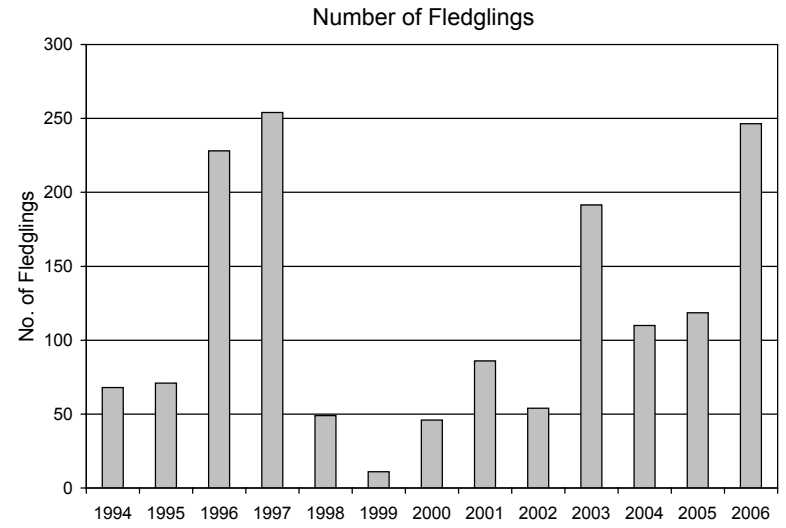

Summary of California least tern nesting history within Batiquitos Lagoon after nesting site construction (1994-2006)

data source: California Department of Fish and Game

Figure 7-4

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Table 7-3. California least tern nesting data from 1994-2006 (nesting sites partly completed in 1994/1995 and fully completed by 1996).

Number of Nests													
Colony	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
E-3			83	110	88	25	0	26	14	40	no data	30	22
E-2			0	7	16	0	0	0	0	0	no data	0	0
E-1		29	37	25	6	11	37	48	58	149	no data	157	160
W-2		3	46	73	86	140	135	121	125	368	no data	363	409
W-1	72	50	39	83	15	0	0	27	29	58	no data	46	36
all sites	**72**	**82**	**205**	**298**	**211**	**176**	**172**	**222**	**226**	**615**	**592**	**596**	**627**
Number of Eggs Laid													
Colony	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
E-3			167	220	151	48	0	45	24	74	no data	47	35
E-2			0	10	30	0	0	0	0	0	no data	0	0
E-1		55	80	48	10	21	66	79	98	282	no data	249	262
W-2		5	97	135	136	261	248	198	219	659	no data	578	671
W-1	147	105	90	161	28	0	0	43	55	110	no data	71	59
all sites	**147**	**165**	**434**	**574**	**355**	**330**	**314**	**365**	**396**	**1125**	**no data**	**945**	**1027**
Number of Eggs Hatched													
Colony	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
E-3			146	185	95	39	0	36	15	56	no data	32	4
E-2			0	8	24	0	0	0	0	0	no data	0	0
E-1		51	78	45	5	0	59	71	73	221	no data	201	211
W-2		4	81	126	112	77	245	172	188	561	no data	448	481
W-1	129	90	81	151	6	0	0	33	48	96	no data	58	56
all sites	**129**	**145**	**386**	**515**	**242**	**116**	**304**	**312**	**324**	**934**	**no data**	**739**	**752**
hatch rate**	**88%**	**88%**	**89%**	**90%**	**68%**	**35%**	**97%**	**85%**	**82%**	**83%**	**--**	**78%**	**73%**
Number of Fledglings*													
Colony	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
E-3			76		2	0	0	5	5	4	no data	3	2
E-2					19	0	0	0	0	0	no data	0	0
E-1		32	20	20	0	0	14	15	12	38	no data	15	42
W-2		3			24	11	32	56	28	109	no data	83	176
W-1	68	36			4	0	0	11	9	42	no data	18	27
W-1&2			132	144									
E-2&3				110									
all sites	**68**	**71**	**228**	**274**	**49**	**11**	**46**	**86**	**54**	**192**	**110**	**119**	**247**
fledge rate***	**53%**	**49%**	**59%**	**53%**	**20%**	**9%**	**15%**	**28%**	**17%**	**21%**	**--**	**16%**	**33%**
nest success****	**0.94**	**0.87**	**1.11**	**0.92**	**0.23**	**0.06**	**0.27**	**0.39**	**0.24**	**0.31**	**0.19**	**0.20**	**0.40**

* When collected data were reported as a range, the mean was calculated and presented in this table.

** Hatch rate: (percent of total eggs laid that survived to hatch)

*** Fledge rate: (percent of total hatched chicks that survived to fledge)

**** Nest success: (fledgling per nest)

Data Sources: CDFG CLT Breeding Survey Annual Reports (D. Marschalek, Patton, Keane, Caffrey)
Draft data tables prepared by R. Patton.
Unpublished draft field notes and personal communication (CLT Monitor S. Wolf)

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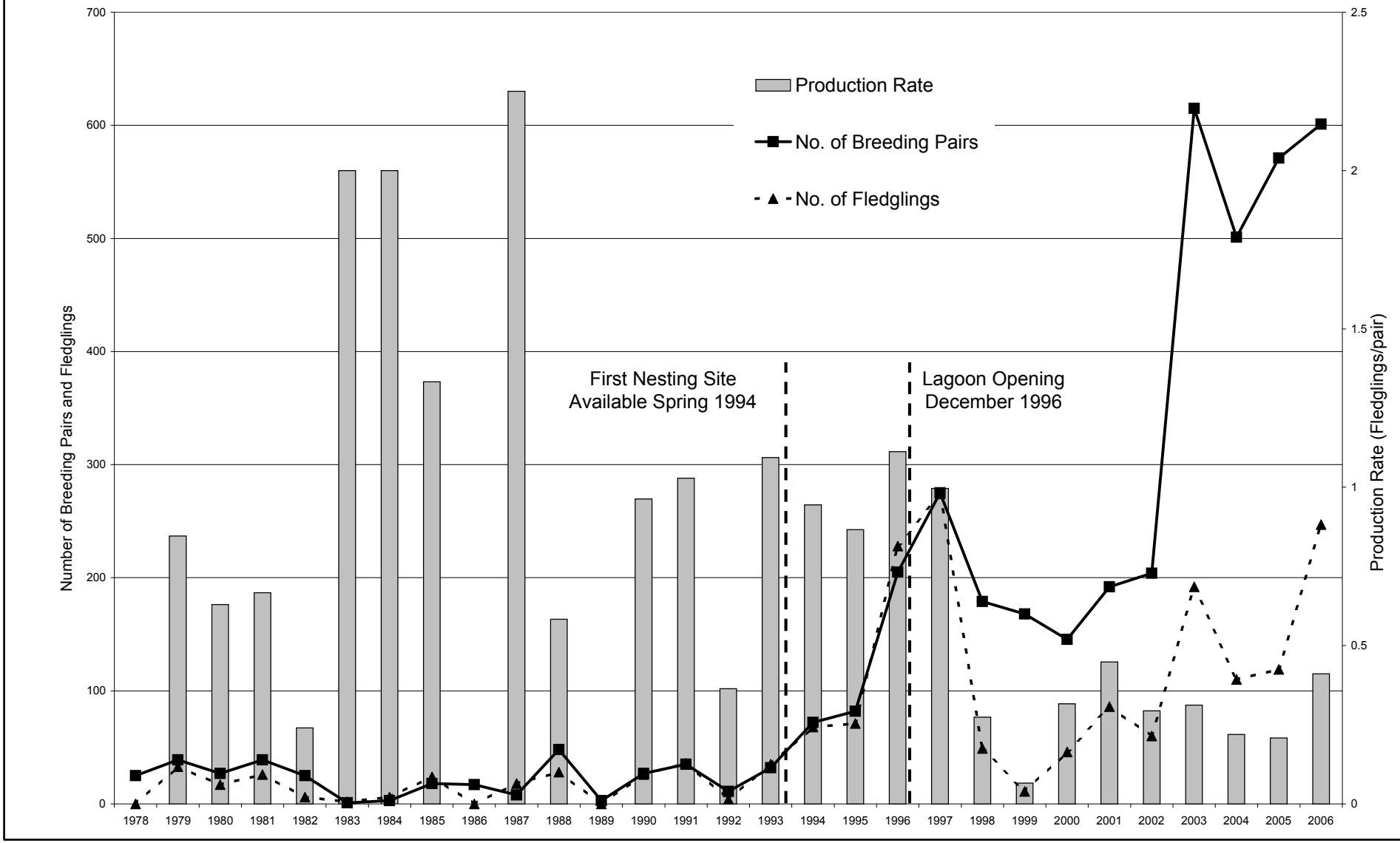

California least tern nesting history, 1978-2006:
numbers of breeding pairs and fledglings and production rate at Batiquitos Lagoon
data source: California Department of Fish and Game

Figure 7-5

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7.2.4 Light-footed Clapper Rail

Dick Zembal regularly conducts focused surveys for light-footed clapper rails within the wetlands of southern California. Zembal found that clapper rails were absent from Batiquitos Lagoon when surveys began in 1980 and continued to be absent through 1992. In 1993 and 1994, one pair of clapper rails was detected, no pairs in 1995, then two pairs in 1996. After the lagoon was opened, while appropriate clapper rail habitat was still minimal, a few breeding pairs were detected in 1997, 1998, 1999, 2000, 2001 (Zembal et al. 2007).

The number of pairs continued to increase as the transplants of the preferred habitat of light-footed clapper rails, Pacific cordgrass, also began to expand. Figure 7-6 shows the increase in clapper rail pairs plotted with the increase in cordgrass habitat. Between 2001 and 2003, the acreage of cordgrass habitat expanded from 2 to 25 acres, with breeding pairs of clapper rails going from three in 2001 and 2002 up to five in 2003. The abundance of high-quality cordgrass habitat that resulted from the restoration project prompted the release of a total of 16 captive-bred clapper rails in 2004 and 2005 through a joint project between the Chula Vista Nature Center, SeaWorld, Dick Zembal, and the USFWS. This release of captive-bred rails successfully assisted in the expansion of rail populations to 19 pairs by 2006.

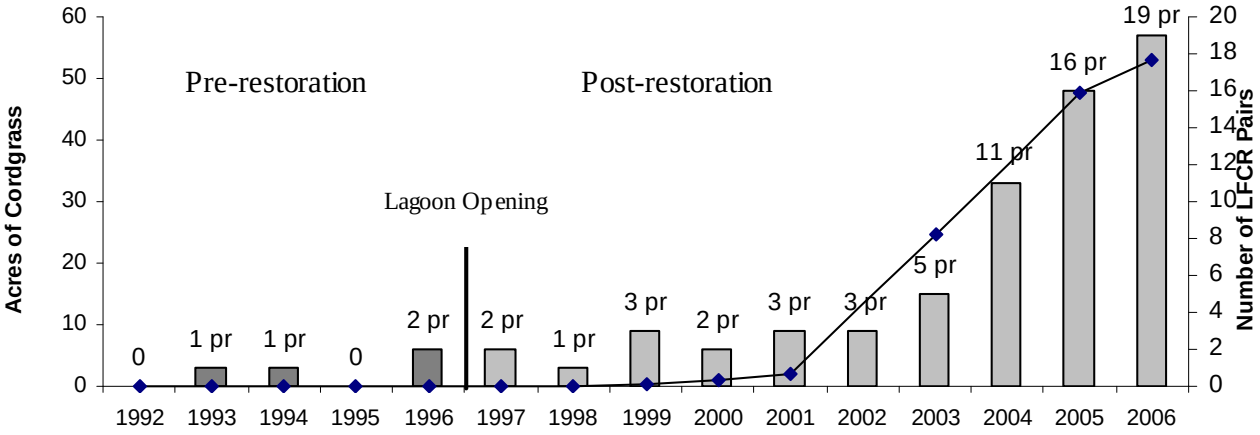

Figure 7-6. Light-footed clapper rail pairs (bars) and cordgrass coverage (line) pre- and post-restoration.

7.2.5 Other Special Status Species

Black skimmers, a CDFG Species of Special Concern (Priority 3), nested at Batiquitos Lagoon on the project-created nesting sites. Data were primarily collected as ancillary notes during other avian monitoring activities, particularly the California least tern and western snowy plover monitoring which occurred in the same nesting areas. Prior to the creation of the nesting sites, the only previously known breeding site of black skimmers within San Diego County was located in south San Diego Bay at the salt works (Unitt 2004). In 1995, a colony of black skimmers initiated nesting (14 pairs) at the W-2 nesting site following its completion and while construction activities still isolated the site from terrestrial predators (Whelchel et al. 1996).

Construction of the E-3 nesting site was completed in October 1995, and the black skimmer colony moved to this site to nest in subsequent years. The data for 1997 reflected an increase in nesting by black skimmers with 28 nests, 81 eggs laid, 67 eggs hatched, and 12 chicks fledged (A. Whelchel pers. comm.). During 1998, approximately 40 black skimmers nested on the E-3 nesting site (A. Whelchel pers. comm.). Productivity of this site, however, was not recorded as most chicks hatched and fledged after the end of the least tern and snowy plover breeding seasons. Only one black skimmer nested in 1999 (A. Whelchel pers. comm.). Data provided to M&A and Unitt (2004) by S. Wolf, Batiquitos Lagoon tern and plover monitor, included 8 pairs/9 nests/19 fledglings in 2001, 42 nests/5 fledglings in 2002, and approximately 26 pairs/21 nests/15-19 fledglings in 2003. No data are available from 2004. Unpublished data collected by S. Wolf in recent years reported 41 nests/3 fledglings in 2005, with black skimmers expanding out to E-1 and returning to W-2 in 2006, with one nest each on E-3, E-1, and W-2. None of those nests were successful due to nest abandonment and nest and chick predation.

Black skimmers were observed during pre-restoration surveys at a rate of 1.7 indiv/survey interval, in surveys during construction at a rate of 6.5 indiv/survey interval, and during post-construction surveys at a rate of 13.7 indiv/survey interval.

In reports of avian surveys conducted by WRA (1995), Michael Brandman Associates (MBA) (1988), and MEC Analytical Systems, Inc (1990) prior to the restoration, there were no records of the state and federally listed endangered least Bell's vireo (*Vireo bellii pusillus*) at Batiquitos Lagoon. A single least Bell's vireo was observed at the lagoon during another biological monitoring task in spring 2006 on the north shore of the east basin, with similar reports of individuals reported by other avian observers in the same location in recent years (M. Baumgartel, pers. comm.). The presence of these birds is likely unrelated to the restoration project, as there was no willow riparian habitat component to this restoration. These vireo were likely migrating through and utilizing the willows and adjacent golf course to forage. There is no evidence of least Bell's vireo nesting at Batiquitos Lagoon.

Many other special-status avian species were observed at Batiquitos Lagoon, including federally endangered California brown pelican (*Pelecanus occidentalis californicus*) and threatened coastal California gnatcatcher (*Polioptila californica californica*), as well as several CDFG Species of Special Concern (SSC): American white pelican (*Pelecanus erythrorhynchos*) (SSC Priority 1), tricolored blackbird (*Agelaius tricolor*) (SSC Priority 1), redhead (*Aythya americana*) (SSC Priority 3), and northern harrier (*Circus cyaneus*) (SSC Priority 3) (Shuford and Gardali 2008). The California brown pelican was observed year round at Batiquitos Lagoon making use of the lagoon's open waters for foraging, and to a greater degree, the sand shoals for loafing. This species was noted in pre-restoration surveys at an average of 2.5 indiv/survey interval. In surveys during construction, pelicans were noted at an average of 25.5 indiv/survey interval, while this number declined to 15.7 indiv/survey interval in post-restoration surveys. The coastal California gnatcatcher was observed at Batiquitos Lagoon over all years and in all surveys. Redhead were observed sporadically during the first years of the survey but were observed year round during 2006. Prior to the restoration, redhead were recorded as nesting at Batiquitos Lagoon in small numbers (Unitt 2004). The American white pelican was commonly observed in very small numbers in all years during the January and April surveys. In 2006, their numbers increased.

The osprey (*Pandion haliaetus*), a highly sensitive species in earlier years though largely recovered now, was absent from the lagoon prior to restoration, but was regularly seen post-restoration, with as many as five individuals seen together simultaneously.

7.3 DISCUSSION

7.3.1 Belding's Savannah Sparrow

Belding's Savannah sparrow territories increased from an estimated 30-31 in 1997 to 142 in 2006. The opening of the lagoon to tidal flow allowed pickleweed dominated salt marsh to expand into areas that were mudflats in 1997. There was also a large expansion of pickleweed in the eastern section of the lagoon where disturbed upland habitat became inundated with salt water. In 2005, the amount of pickleweed salt marsh at Batiquitos Lagoon had declined from 2003 due to conversion of some pickleweed at lower elevations into cordgrass marsh in relationship to increased inundation frequencies with increased tidal muting. Similar ratios of pickleweed to cordgrass were seen in 2006. It is not clear whether the pickleweed extent has reached a point of stabilization, although it is believed with continued muting, cordgrass will expand shoreward, transitioning more pickleweed dominated marsh to cordgrass dominated marsh, rendering these areas unsuited to Belding's Savannah sparrows. Future maintenance dredging efforts may result in continued shifts in the extent of mudflat, pickleweed, and cordgrass when restoration of the tidal range tidal changes inundation frequencies at the low and middle marsh elevations. It is likely that the dense pickleweed at the far eastern end of the lagoon, as well as at the upper elevations of the north and south shore of the east basin, will remain a consistent habitat available for continued Belding's Savannah sparrow nesting. The overall increase in territories is reflective of the continued availability of an abundance of pickleweed dominated salt marsh habitat on which Belding's Savannah sparrows depend.

It is notable that Zembal et al. (2006) documented only 37 territories at Batiquitos Lagoon in March 2006 in comparison to the 142 territories found in the April and June 2006 surveys conducted under this monitoring program. The disparity could be the result of several factors. First, the Zembal survey was conducted one month before the April 13 survey, which may account to a very limited degree for additional territories detected in April due to increased territorial behavior at the later date. Secondly, the Zembal survey was conducted during a total of six field-hours divided amongst three surveyors, whereas the April and June surveys by M&A were conducted over 40 and 38 field-hours, respectively, by a team of six surveyors. By 2006, the habitat occupied by Belding's Savannah sparrows had expanded to a widely distributed 118 acres and required extensive field time to access and assess the large area. Some survey areas were also added as vegetation developed, thus it is possible not all areas were covered in the statewide surveys. Additionally, the survey methodology employed does not standardize the large variation in Belding's Savannah sparrow activity from day to day. Belding's Savannah sparrow survey testing conducted at Bolsa Chica found that repeated surveys of the same area found as many as 25% more territories on one day than the other due to variability in bird behavior (M&A 2008), illustrating the limitations of the present survey methodology, which captures a snapshot in time and provides only an estimate of territories. Lastly, result differences between the Zembal and M&A team could also have arisen from a difference in survey biologists. Without written survey protocols and standardized methods for coverage on a time

per unit area basis, it is not possible to have complete consistency between teams. Each of these factors may have, in part, contributed to the differences in 2006 territory assessments.

7.3.2 Western Snowy Plover

Based on this study, reproductive success for the western snowy plover at Batiquitos Lagoon would be considered low. Over the 10-year study, nest success average (0.69 fledglings per nest) was lower than the average nest success rate reported in a study conducted from 1994 to 1999 throughout San Diego County (Powell et al. 2002). The regional results from this study were even considered low compared to the rest of California. A review of snowy plover nest success at Bolsa Chica Ecological Reserve from 1998 to 2006 found an average nest success of 0.99 fledglings per nest (Knapp and Peterson 2009). While some of the lower success at Batiquitos Lagoon may have been attributable to natural inter-annual variation in nesting success and regional factors, some failure may be due to the poorly maintained condition of the nesting sites. Several of the sites, particularly those in the far eastern basin (E-2 and E-3), were increasingly covered by heavy vegetative growth from 1996 onward through 1999. Weedy vegetation had dominated the shoreline above the high tide line on many of the nesting sites and in some places encroached into the nesting area. The vegetation included both weedy, non-native species such as pampas grass (*Cortaderia jubata*), horseweed (*Conyza canadensis*), tree tobacco (*Nicotiana glauca*), and crystalline iceplant (*Mesembryanthemum crystallinum*), as well as native species such as goldenbush (*Isocoma menziesii*) and telegraph weed (*Heterotheca grandiflora*).

A wide band of pickleweed expanded to encompass the shoreline on all east basin nesting sites (see Figures 3-3a-d in Chapter 3). The increased vegetation density not only limited snowy plover nesting habitat, but it also hindered the ability of chicks to follow their parents to the shoreline where preferred insect prey occurs at higher densities than on nesting sites. To address this, all sites, with the exception of E-3 in the east basin, were cleared by CDFG prior to the 2000 and 2001 nesting season. Also, sites with shoreline interfaces were cleared to the waterline at discrete cuts through the pickleweed marsh. The degree of on-going maintenance of corridors to the shoreline since that time is not known. However, efforts have been too inconsistent to effectively reduce the seed bank of weedy species, and regular maintenance remains a chronic need. Another factor that may affect availability and abundance of insect prey is conversion of mudflats to salt marsh with the expansion of cordgrass. For example, mudflats that were once available at E-1 are now covered with cordgrass and are no longer available to foraging chicks (see Figures 3-3a-d in Chapter 3).

In addition to forage resource limitations, predation by coyotes (*Canis latrans*), ravens (*Corvus corax*), and red-tail hawks (*Buteo jamaicensis*) was damaging to overall productivity of western snowy plovers (and California least terns) during the early years. In recent years, CDFG predator control activities have been conducted year round to remove potential predators from the area, though data on the effort or its effectiveness have not been made available.

The management goal for Batiquitos Lagoon, according to the Snowy Plover Recovery Plan (USFWS 2007), is to support 70 individual birds. In order to reach these goals, greater levels of active management are required to identify problems and attempt to rectify them prior to the onset of subsequent breeding seasons.

7.3.3 California Least Tern

Post-restoration, California least tern nesting at Batiquitos Lagoon has increased by an order of magnitude. This increase is highly encouraging and demonstrative of the viability of developing suitable nesting and foraging habitat for this species on a large-scale basis. It is notable that one of the greatest periods of population increase and the period of the greatest fledgling production rates over the 29-year monitoring history at Batiquitos Lagoon occurred during the period of active dredging and restoration construction within the lagoon. While the post-restoration increase in nesting and a coincident increase in fledglings is a very positive sign, the reduced nest success is suggestive of greater management need. Although the hatch rate has remained high almost every year of the study period, the fledge rate is very low, indicating that the most substantial reproductive loss is occurring during the period between when the chicks hatch and when they fledge.

The statewide reports Marschalek (2007, 2006, 2005), Patton (2002a, 2002b), Keane (1998a, 1999, 2001), and Caffrey (1995, 1998) provide overall nest and fledgling numbers from which a comparable nest success (fledglings per nest) value can be estimated (rather than using the fledgling per breeding pair statistic reported in the statewide reports). Table 7-4 aligns these values with the annual nest success rates at Batiquitos Lagoon. The statewide range reflects uncertainty in the exact number of fledglings each year.

Table 7-4. Statewide California least tern nest success data compared to Batiquitos Lagoon during restoration (1995-1996) and post-restoration (1997-2006).

Least Tern Nest Success (fledgling/nest)		
Year	**Statewide**	**Batiquitos Lagoon**
1995	0.57 - 0.60	0.87
1996	0.49 - 0.52	1.08
1997	0.71 - 0.75	0.97
1998	0.59 - 0.62	0.23
1999	0.15 - 0.16	0.06
2000	0.70 - 0.76	0.27
2001	0.46 - 0.55	0.39
2002	0.11 - 0.20	0.24
2003	0.29 - 0.41	0.31
2004	0.17 - 0.20	0.19
2005	0.21 - 0.30	0.20
2006	0.44 - 0.45	0.39

Sources: Caffrey 1995, 1998; Keane 1998a, 1999, 2001, Patton 2002a, 2002b, Marschalek 2005, 2006, 2007

During and immediately following construction of the nesting sites, Batiquitos Lagoon had a nesting success much higher than the statewide success, likely due to the intensive site management conducted during this time period. In 1997, it was speculated that some fledglings counted at Batiquitos were in fact fledglings from the Santa Margarita River sites, leading to

misleadingly high nest success rates (Keane 1998a). In most post-restoration years, Batiquitos Lagoon fell below the statewide range of nest success, with the exception of 2002, when the lagoon exceeded the state range, and 2003 and 2004, when the lagoon fell within the state range.

The moderate to poor nest success of the least tern nesting sites at Batiquitos Lagoon is of concern due to the importance of the site to the statewide nesting population. In 2006, Batiquitos Lagoon supported the fourth largest number of breeding pairs (after Camp Pendleton, Naval Base Coronado, and Los Angeles Harbor) and accounted for 13% of the statewide total of nests (Marschalek 2007). The very high numbers of nests established at the nesting sites (more than 600 in 2006) indicate the great potential of the site to contribute to the recovery of the species statewide, provided enough site management is provided to support the nests through to successful fledging.

Early notes on low reproductive success speculated that high predation pressure and disturbance by fishermen on or near the nesting sites may have caused nest abandonment and chick mortality (Keane 1998b, 2001). Some information on the limited reproductive success at Batiquitos Lagoon in recent years is available in the statewide reports (Marschalek 2007, 2006, 2005). In 2004, starvation of chicks, particularly at the sites in the west basin, was cited as the primary cause of losses, with only one reported case of predation. In 2005, there was also high chick mortality at the western sites. The cause was not given, but predation was still cited as being very low. The 2006 statewide report also noted high chick mortality at four large sites, including Batiquitos Lagoon, suggesting that weather or food shortage had caused up to 25% of the chick death at the four sites. Predation was reported to be low at Batiquitos Lagoon specifically. Batiquitos Lagoon Ecological Reserve Manager, Tim Dillingham, has reported that in several monitoring years, unspecified numbers of chicks were found dead on some nesting sites for a period of several weeks and that the dead birds were tested for various pathologies with no causative agent found (T. Dillingham pers. comm.). Specifics on these observations have not been provided by CDFG; and it is not known what years this occurred, how many chicks were involved, at which nesting sites, or what conditions were tested for and eliminated as possible causes of mortality.

An examination of the fisheries data collected throughout the study found no correlation between the number of fledglings and the density of topsmelt (*Atherinops affinis*), a common prey item of terns, in the lagoon. An exception would be in 1999 when least tern reproductive success fell sharply and there was a low count of topsmelt (see Figure 5-3 in Chapter 5). In 2006, however, topsmelt density dropped again to levels similar to those in 1999, but there was an increase in the number of least tern chicks surviving to fledge. The number of deepbody anchovy (*Anchoa compressa*), another common prey item, declined over the duration of the monitoring program, with the densities seen in 1997, 1998, and 1999 roughly double what was seen later in 2001, 2005, and 2006. However, in all reviewed data and reports, no suggestion has been made that limited prey availability was a suspected cause of chick mortality at Batiquitos Lagoon. The persistent and increased nesting and egg production by adults over time suggests food availability was not a likely limiting factor at Batiquitos Lagoon.

Based on the field observations, site preparation could increase the number of nesting terns on the site. Least terns prefer sites with sparse vegetation cover. Vegetation density increased

rapidly at the nesting sites following their creation. Vegetation overgrowth continues to be problematic at this time. This was particularly an issue at E-3, an island that is challenging to access with vegetation-removal equipment and was covered by heavy vegetative growth as early as one year after its creation. Additionally, CDFG staff has reported that the presence of the heron rookery in the eucalyptus near E-2 discourages use of the site by least terns (T. Dillingham, pers. comm.).

It is anticipated that CDFG staff and seasonal monitors will be able to provide greater insight into the reproductive status and management needs at the nesting sites with the completion of upcoming monitoring reports. The need for greater management activities to move the fledging rate upward is imperative.

7.3.4 Light-footed Clapper Rail

One of the most successful and less expected benefits of the Batiquitos Lagoon restoration has been the increase in habitat and, ultimately, population of light-footed clapper rail. The remarkable success of this species has been the result of enormous success in cordgrass introductions (see Chapter 4) followed by natural population growth and sustained captive breeding program introductions. Prior to the restoration of the Batiquitos Lagoon system, clapper rails were only intermittently represented by single occurrences. By 2006, Batiquitos Lagoon supported the fifth largest population of light-footed clapper rails in California at the time (Zembal et al. 2007). However, the generally low number of rails at Batiquitos Lagoon is an indication of the imperiled nature of the species and the critical role the restored lagoon plays in its conservation.

The persistence of dense and tall cordgrass habitat is critical to maintaining this species at the high numbers represented. It is anticipated that further population expansions may occur in coming years. The present lagoon environment is well suited to clapper rail presence, although changing tidal conditions associated with restoration of tidal prism or further muting are likely to alter the availability of cordgrass upward or downward through time. There are few specific management activities that are warranted or could be suggested that would specifically favor this species. It is more important that an overall healthy lagoon system be maintained than that any specific targeted action be taken relative to single species management needs.

7.3.5 Other Special Status Species

There were no records of black skimmer nesting at Batiquitos Lagoon prior to the creation of the nesting sites in 1995. This species, however, came into the lagoon environment and commenced nesting fairly rapidly after suitable island habitats were made available. While this species' numbers continue to dwindle, they persist in nesting within the lagoon. It is believed that active management of the E-3 colony, including restoration of the surrounding subtidal moat and removal of vegetation from the island crown, would foster the rejuvenation of nesting at this site. Skimmers have experienced some years of reasonably high reproductive success; however, the number of fledglings produced is highly varied from year to year. Black skimmers are easily affected by human disturbance and are highly subject to depredation. The fish data do not indicate that there was a shortage of prey within the lagoon (see Chapter 5).

Neither the California brown pelican nor the American white pelican breed at Batiquitos Lagoon. The lagoon, however, does offer sheltered foraging areas for both species and the brown pelican uses the sand shoals for loafing. The persistence of large fish populations is a benefit to these species' use of the system.

Much of the historic brackish marsh at Batiquitos Lagoon has transitioned into salt marsh habitat (see Chapter 3). Redheads prefer nesting in fresh or brackish water marshes, making it unlikely that this species would nest in high numbers within the restored lagoon. There are, however, some areas at the mouth of Encinitas Creek that continue to maintain freshwater and brackish marsh conditions along with open brackish ponds. These areas are likely suitable to support some limited continued nesting by this species. The lagoon does offer considerable wintering foraging areas for this species, which has been observed in several January surveys.

The coastal California gnatcatcher is not a migrating species and has been observed year round at the lagoon. It is likely that the gnatcatcher nests in the upland areas near the lagoon. The observation of a migrating least Bell's vireo in the willows in 2006 is likely an indication of expanding occurrence of this species within its natural range. It would not be unexpected for vireos to ultimately nest within willows found at the lagoon. It is most likely that vireo nesting would occur within the willow grove at the mouth of Encinitas Creek by the intersection of La Costa Avenue and El Camino Real within the south easternmost portion of the lagoon. This potential future nesting within the lagoon woodlands is not anticipated to relate to effectiveness of lagoon restoration. In that it is likely to occur, however, it would bring further resource values and management value to the lagoon system.

Although not currently considered a special status species, the presence of osprey at the lagoon post-restoration reflects its significant recovery after dramatic declines in the 1950's and 1960's due to the toxic effects of insecticides on its reproduction. Opportunities for promoting nesting at Batiquitos Lagoon by osprey are considered to be very high, and consideration should be given to the erection of an over-water nest platform in the central basin.

7.4 RECOMMENDATIONS

The California least tern, western snowy plover, Belding's Savannah sparrow, light-footed clapper rail, and black skimmer have all benefited in some way by the restoration at Batiquitos Lagoon. In order to effectively manage these sensitive species, while increasing the health of Batiquitos Lagoon, however, the following recommendations are being made.

- Continued monitoring of special-status species is recommended. Monitoring of California least tern and western snowy plover nests should continue on an annual basis to assess the viability of the nesting sites and their on-going maintenance issues over time. Regular reports that assess the success and seek to identify management needs and actions should be prepared annually, and management actions recommended in the reports should be implemented.

- Spring surveys for Belding's Savannah sparrow and light-footed clapper rail should also continue at a minimum of every five years.

- Although incidental reproductive success information has been collected for the black skimmer, further specific studies, monitoring, and management actions should be considered for this species. These include dredging a tidal moat around E-3 and maintaining better colony clearing for nesting purposes.

- There remains a continued need for aggressive maintenance of the five nesting sites within Batiquitos Lagoon. Due to the extensive overgrowth of vegetation that currently occurs on the sites and along the shoreline, it is critical that vegetation removal and other site maintenance be completed early in March, prior to the start of the nesting season.

- To benefit plover chick access to mudflats, 10+-foot wide breaks in the pickleweed should be developed at least every 50 feet along the edge of the E-1 and E-3 nest sites. This can be accomplished by herbicide treatment in the fall or spreading heavy vinyl tarps for periods of a couple of weeks to solarize the areas, killing off vegetation.

- Consideration should be given to the erection of an over-water nest platform in the central basin to promote nesting by osprey.

- Increased urban development around the lagoon has eliminated foraging areas for many predators that now seek prey within the lagoon nesting sites. On-going and target specific predator management activities remain necessary to control this problem.

- Expanded signage at nesting sites, particularly at W-2, is necessary to prevent human intrusion into and near nesting areas. Such intrusion can result in temporary nesting site abandonment and reductions in productivity.

- The slope from the W-2 nest site to the beach is presently a steep, eroded scarp. Cobble should be placed in this area to develop a transition that may be used by snowy plover chicks and to stabilize the site against further colony loss. Eroded sand should be reclaimed from the west basin and placed back onto the colony to restore colony size.

- As-needed maintenance dredging, as discussed in Chapter 2, will ensure the continued health of cordgrass habitat for light-footed clapper rails, pickleweed marsh habitat for Belding's Savannah sparrows, and shallow water foraging habitat for least terns.

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